Transactions of the Royal Society of S. Aust. (1998), **122**(4), 159-165.

A NEW SPECIES OF FROG (ANURA: MICROHYLIDAE) FROM CAPE MELVILLE, QUEENSLAND

by MARGARET DAVIES[1] & KEITH R. MCDONALD[2]

Summary

DAVIES, M. & MCDONALD, K. R. (1998) A new species of frog (Anura: Microhylidae) from Cape Melville, Queensland. *Trans. R. Soc. S. Aust.* **122**(4), 159-165, 30 November, 1998.

Cophixalus zweifeli sp. nov. is a relatively large member of a genus of microhylid frogs restricted to New Guinea and the Cape York Peninsula of Queensland. The new species is found in boulder fields in the Cape Melville National Park. Females are characterised by having flame-scarlet axillae, groins and hidden parts of the hind limbs. Males have not been observed. The finger discs are expanded. Morphologically the species is allied to *C. saxatilis*, but unpublished mitochondrial DNA sequences link it with *C. infacetus*. The description of this taxon brings the number of species of the genus in Australia to 13.

KEY WORDS: *Cophixalus zweifeli*, new species, osteology, Microhylidae, morphology.

Introduction

Fauna surveys have been conducted in Cape York Peninsula by the Queensland Department of Environment (and its predecessors) since 1975. Information on the vertebrate fauna of the area has been reviewed by Winter & Leithbridge 1995[3] as part of Stage 1 of the Cape York Peninsula Land Use Study. Subsequently fauna and flora surveys in Cape Melville National Park have located significant new records for mammals, reptiles, frogs, earthworms and vegetation types (Stanton 1994[4]; Little & Hall 1996; Stanton & Fell 1996[5]; Jamieson 1997; McDonald 1997, 1998, unpub.). The area of Cape Melville National Park was increased from 36 000 ha to 137 000 ha in 1995, thus incorporating a greater diversity of habitats and an increase in the range of flora and fauna in the park. The new area includes assemblages of topography, geology and vegetation types unique to Cape York (Stanton 1994[4]), so the Cape Melville National Park is an area of proven and potential endemism (Covacevich & Ingram 1978; Stanton & Fell 1996[5]; Jamieson 1997; McDonald 1997).

A large hylid frog (*Litoria andiirmalin* McDonald, 1997) was discovered in boulder fields of the Melville Range. In addition, a second new frog species was located amongst boulders. This species was recognised as a member of Microhylidae, a family well represented in New Guinea but with Australian representatives restricted to the subfamily Genyophryinae in two genera *Cophixalus* and *Sphenophryne*. Australian microhylids are confined to northeast Queensland, with the exception of *Sphenophryne adelphe* Zweifel, 1985, a species found in the north of the Northern Territory (Tyler & Davies 1986). Australian microhylids were reviewed by Zweifel (1985) who recognised 16 species, seven of which he described at that time. Richards *et al.* (1994) described *Cophixalus monticola* from the Carbine Tablelands, northeast Queensland and here we describe a further *Cophixalus* from Cape Melville.

Materials and Methods

The material studied is deposited in the Queensland Museum, Brisbane (QM) and the South Australian Museum, Adelaide (SAMA). Measurements were made with dial calipers reading to 0.01 mm. Measurements taken (in mm) were : tympanum diameter (T), eye to naris distance (EN), eye diameter (E), foot (F), hand (H), head width (HW), head length (HL), internarial span (IN), snout to vent length (SV), tibia length (TL), width of third finger disc and of penultimate phalanx, width of fourth toe disc and of penultimate phalanx, length of hand and length of foot and follow Zweifel (1985) and Tyler (1968). Material was cleared and stained using a modification of the method of Dingerkus & Uhler

[1] Dept of Zoology, University of Adelaide Australia 5005.
[2] Conservation Strategy Branch, Department of Environment, PO Box 834 Atherton Qld 4883.

[3] WINTER, J. W. & LEITHBRIDGE, P. J. (1995) Terrestrial vertebrate fauna of Cape York Peninsula. Cape York Peninsula Land Use Strategy. Natural Resources Analysis Program, Brisbane, Queensland, Office of the Co-ordinator General.

[4] STANTON, J. P. (1994) Cape Melville National Park: Resource information. (Internal report for the Queensland Department of Environment and Heritage)

[5] STANTON, J. P. & FELL, D. (1996) Rainforests of Cape York. (Internal report for the Queensland Department of Environment).

(1977). Description and discussion of osteology follow Zweifel (1985).

Results

The new species is assigned to *Cophixalus* on the basis of the following features: dentaries not in contact; vertebral column procoelous; tongue ¼ free behind with no furrow or pouched pocket; maxillae not in contact (relationship with premaxillae indeterminable). This combination of features assigns the species to the Genyophryninae (Zweifel 1971).

In addition, the species lacks procoracoids and clavicles; has a snout that is not narrow or elongate and lacks a hypertrophied serous gland on the snout. The other defining feature of *Cophixalus*, the alary process being typically slender and not merging insensibly into the body of the bone, could not be determined.

Cophixalus zweifeli sp. nov.
(FIGS 1-4)

Holotype: ♀ QM J64888 (formerly QNPWS N29789) Cape Melville National Park, 14° 15' 3" S, 144° 27' 40" E, altitude 60-80 m. 17.ii.1995. Coll. K. R. McDonald and L. A. Jackson.

Paratypes: ♀ SAMA R51080 16.ii.1995. Same location and collectors as holotype; ♀ QM J64889 (formerly (QNPWS N73038) Cape Melville National Park, Permanent Camp Qld (near type locality), altitude 40 m. 14.xii.1995. Coll. J. O'Shea (cleared and stained).

Definition

A large species (♀♀ 40.1-45.4 mm SV) with long legs, large finger discs with third finger disc larger than fourth toe disc, an elongate snout; dorsal colouration brown with flame-scarlet axilla, thigh flashes and ventral leg markings.

Description of Holotype

Head slightly narrower than body; legs moderately long (TL/SV 0.51); snout truncate from above, straight and slightly projecting in profile (Figs 1, 2), canthus rostralis straight, loreal region steeply sloping; nares anterolateral on tip of snout; eye to naris distance greater than internarial span (EN/IN = 1.125); eyes moderately large, corneal outline clearly visible from beneath; interorbital width greater than width of upper eyelid. Tympanum large, obscure dorsally, diameter greater than half eye diameter.

Relative lengths of fingers 3>4>2>1, the first slender and approximately half the length of the second (Fig. 3). Discs of fingers 2-4 greatly enlarged and truncate, that of first barely extending beyond width of penultimate phalanx (Fig. 3); subarticular tubercles rounded, moderately prominent. Low,

Fig. 1. *Cophixalus zweifeli* sp. nov. in life (SV 41.5 mm).

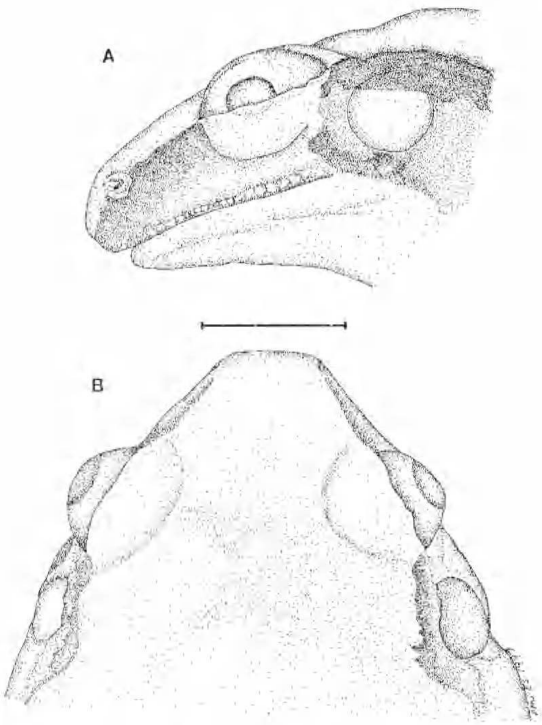

Fig. 2. *Cophixalus zweifeli* sp. nov. A. Lateral and B. Dorsal views of head of holotype (QM J64888). Scale bar = 5 mm.

ovoid inner and outer palmar tubercles. Relative lengths of toes 4>3>5>2>1 (right foot), toe three abnormally short on left foot; length of first toe approximately half that of the second. All toes with enlarged truncate discs with terminal grooves. Discs on first and fifth toes smallest and approximately same size. Toe discs smaller than those of fingers 2-4 (Fig. 3). Subarticular tubercles rounded, moderately prominent. Low elongate inner metatarsal tubercle, no outer metatarsal tubercle.

Dorsal and ventral surfaces smooth.

Colour and pattern: dorsum tan with darker brown pigment spots above insertion of arm, along flanks and superior to inguinal region and along midvertebral region; large faint mark between and posterior to eyes; dark canthal stripe from tip of snout, through nostril and eye and above and slightly posterior to tympanum. Pale crescent along anterior

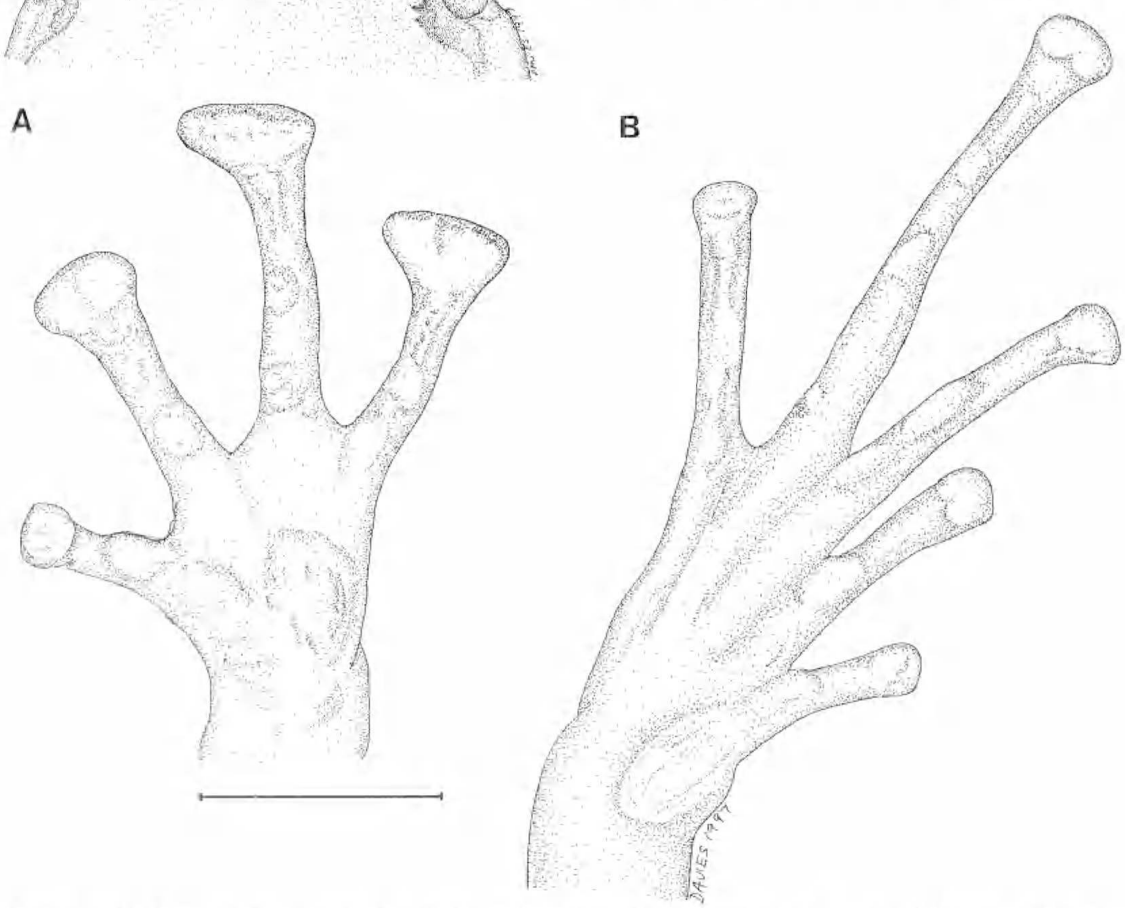

Fig. 3. *Cophixalus zweifeli* sp. nov. A. Palmar view of left hand. B. Plantar view of right foot of holotype (QM J64888). Scale bar = 5 mm.

rim of tympanum and paler stripe along lower rim of eye. Dark brown pigment patches on dorsal surfaces of hand and forelimb. Lesser pigment spots on dorsal surface of foot; dark patches along anterior edge of tibia. Throat very lightly dusted with pigment, more concentrated around margin of jaw and speckled with white.

Measurements

SV 40.1; TL 20.6; HW 13.9; HL 13.4; E 4.5; T 3.1; EN 3.6; IN 3.2; third finger disc 2.2 (penultimate phalanx 1.0); fourth toe disc 1.9 (penultimate phalanx 0.7); hand 11.7; foot 7.3; TL/SV 0.51; HW/SV 0.35; HL/SV 0.33; EN/IN 1.125; HL/HW 0.96, E/SV 0.11; IN/SV 0.08, third finger disc/SV 0.054; fourth toe disc/SV 0.047; hand/SV 0.29; foot/SV 0.45; EN/SV 0.090; T/E 0.69.

Colour in life

Dorsal surface beige when first observed at night, darkening to tan during the day with widely scattered, irregular brown speckles. Brown mottling on arm and thigh dorsal surface. Black canthal streak from snout through eye and above tympanum. Lateral dark brown mottled marking between axilla and groin. Axilla, groin, hidden parts of thigh, ventral tibia and inner half of foot flame scarlet (Smithe 1975). Ventral surface densely mottled light purple on throat and chest becoming more diffuse posteriorly. Ventral surface of femur and arm mottled with brown. Dull yellowish wash on lower third of abdomen and under the femur. Brown ventral surface to hand and foot.

Variation

The two paratypes have the following measurements:

SAMA R51080: SV 41.5; TL 22.2; HW 12.8; HL 14.4; E 5.0; T 3.3; EN 4.0; IN 4.2; third finger disc 2.5 (penultimate phalanx 1.2); fourth toe disc 1.7 (penultimate phalanx 0.6); hand 12.1; foot 19.1; TL/SV 0.54; HW/SV 0.31; HL/SV 0.35; EN/IN 0.95; HL/HW 1.13; E/SV 0.12; IN/SV 0.10, third finger disc/SV 0.06; fourth toe disc/SV 0.04; hand/SV 0.29; foot/SV 0.46; EN/SV 0.096; T/E 0.66. QM I64889: SV 45.4; TL 20.8; HW 14.2; HL 13.0; E 4.1; T 3.4; EN 3.6; IN 3.5; third finger disc 2.45 (penultimate phalanx 1.8); fourth toe disc 1.9 (penultimate phalanx 0.6); hand 10.8; foot 19.5; TL/SV 0.46; HW/SV 0.32; HL/SV 0.31; EN/IN 1.03; HL/HW 0.92; E/SV 0.09; IN/SV 0.077; third finger disc/SV 0.053; fourth toe disc/SV 0.042; hand/SV 0.24; foot/SV 0.43, EN/SV 0.079; T/E 0.83

Dorsal colour is more brown than tan in SAMA R51080 and the markings are more distinct. The ventral surface, in particular at the throat and anterior abdomen, is more heavily and irregularly pigmented with a faint white stripe medially. The undersurface of the thighs is more heavily speckled.

Comparison with other species

Cophixalus zweifeli sp. nov. is a very large species of Australian microhylid comparable only with *C. saxatilis* Zweifel & Parker, 1977. In addition, the third finger disc of the new species is larger than that of the fourth toe, a feature shared by *C. saxatilis* and *C. ornatus* (Fry, 1912). This latter species is smaller than either *C. zweifeli* or *C. saxatilis*. The canthus rostralis is straight in *C. zweifeli* compared with a rounded canthus in *C. saxatilis*. The snout of *C. zweifeli* is longer than that of *C. saxatilis*. The distinctive flame-scarlet colouration on the hidden surfaces of legs is not found in any other *Cophixalus* in Australia. Females of *C. saxatilis* are canary yellow at night, darkening to a light tan during the day. Unpublished data of C. Hoskin from mitochondrial DNA sequences show *C. zweifeli* to be a sister taxon to *C. infacetus* Zweifel, 1985 and in a separate clade from *C. saxatilis*. *Cophixalus infacetus* is a small species (females to 17.6 mm SV) with a rounded canthus rostralis, features not shared by *C. zweifeli*. In life, *C. infacetus* is dark grey on the underside, compared with the purplish colour of the throat and chest of *C. zweifeli*.

Osteology

One paratype was cleared and stained, but unfortunately because of poor preservation, the material did not remain intact throughout the maceration process. However, characteristic and diagnostic features were obtainable.

Skull: The skull is toothless with well-developed and well-ossified nasals and frontoparietals. The quadratojugal articulates with the maxilla. The eleutherognathine condition of the premaxillae, typical of the Genyophryinae, could not be confirmed. The otoccipital region (prootic and exoccipital) is ossified and the bones are closely associated with each other. The vomers have a well-developed transverse arm (probable fused vomer and palatine) arising from an expanded area in the midline of the palate, and an anterior arm that passes mesial to and then anterior to the internal nares. The transverse arm reaches the maxillary shelf although remaining tied to the maxilla by cartilage (Fig. 4). The pterygoid is extremely robust.

There is a thickened median portion of the hyoid plate and the posterior cornua have well-developed flanges (Fig. 4).

The pectoral girdle lacks clavicles and a very small medial projection may represent a vestigial omosternum (Fig. 4). Calcification is absent in the mesosternal region.

Presacral vertebrae are non-imbricate. Relative widths of transverse processes are: III=SD>IV>II =V=VI=VII=VIII. Vestigial transverse processes are apparent on the urostyle.

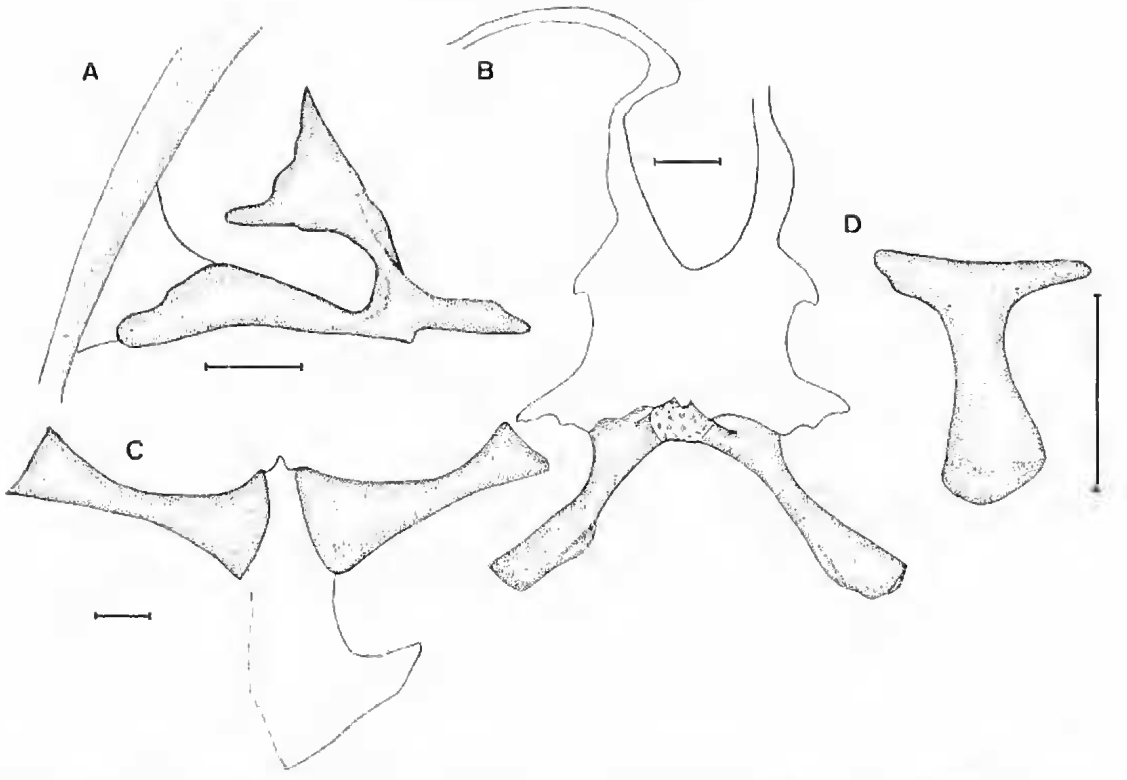

Fig. 4. *Cophixalus zweifeli* sp. nov. A. Right vomerine bone in ventral view. B. Dorsal view of hyoid plate. C. Ventral elements of pectoral girdle. D. Terminal phalanx of finger (Paratype QM J64889). Scale bars = 1 mm.

The tips of the terminal phalanges of the hands and feet are T-shaped (Fig. 4).

Comparison with other species

Zweifel (1985) examined the osteology of 11 species of Australian *Cophixalus* and the current comparison is with these data.

The otoccipital region of *C. zweifeli* is similar to that of *C. saxatilis*, *C. concinnus* Tyler, 1979, and *C. exiguus* Zweifel & Parker, 1969. *Cophixalus infacetus* and *C. hosmeri* Zweifel, 1985 have the ossification of the prootics restricted to buried nubbins, as seen from above. The other species examined by Zweifel have an intermediate condition between these two extremes.

The fused vomers and palatines of *C. zweifeli* approach those of *C. concinnus* in their relationship with the maxillary shelf, whilst the mesial extension approaches that of *C. ornatus*. The anterior portion of the complex approaches that of *C. saxatilis* although it is more robust in *C. zweifeli*.

Zweifel did not recognise characters in the hyoid as being useful in interspecific comparisons.

Some *Cophixalus* (including *C. saxatilis*) have a small cartilaginous protrusion on the anterior ventral midline of the pectoral girdle (? vestigial omosternum). A smaller process is apparent in *C. zweifeli*.

The terminal phalanges lack a median notch found in *C. infacetus*, *C. saxatilis* and *C. ornatus*.

Distribution

The species is known only from the type locality in Cape Melville National Park.

Habitat

The habitat of *C. zweifeli* sp. nov. is restricted to boulder fields of Altanmoui granites (Fig. 5). The holotype and paratype (SAMA 51080) were located at the base of rocks at night near a creek flowing through the rock formation. No calling was heard. Paratype (QM J64889) was found on a rock in a stream flowing out of the boulders.

Etymology

This species is named for Richard G. Zweifel, former Curator of Herpetology at the American Museum of Natural History, New York, whose revision of the Australian microhylids is a standard reference. We honour his contribution to herpetology and his friendship.

Discussion

Morphologically *Cophixalus zweifeli* appears to be a sister species to *C. saxatilis*. Both are large frogs, the largest of any Australian microhylid, and similar in body proportions. The flame-scarlet colouration in the axilla, groin and on the legs is unique to *C. zweifeli*.

In addition to morphological appearance, *C. zweifeli* and *C. saxatilis* utilize similar habitats of granitic boulder fields with patches of closed vegetation in moist pockets (Fig. 5; see Zweifel & Parker 1977, Fig. 7 for the habitat of *C. saxatilis*). This form of habitat is restricted to the Melville Range and Black Mountain in Cape York Peninsula. Similar small areas of just a few hectares are found in numerous locations in eastern Queensland (Stanton 1994). The direct distance from Black Mountain to the Melville Range is 175 km. Rainfall around the Cape Melville Range is estimated to be as high as 2000 mm (some 700 mm higher than the surrounding country) (Stanton 1994).

Notwithstanding the morphological linking of *C. zweifeli* with *C. saxatilis*, Hoskin's data from mitochondrial DNA sequences link the species with *C. infacetus* in a separate clade from *C. saxatilis*. Zweifel (1985) attempted to derive a tree of relationships amongst *Cophixalus* using external morphological characters but found this to be "unsatisfying" (Zweifel 1985 p. 370). Zweifel did not believe that any one of his most parsimonious trees was defensible. Given the non-congruence between morphological and biochemical data indicated here, it is clear that a more robust morphological study using other morphologies than external features is needed as a test of the robustness of the mitochondrial DNA data. If the data are copious, independent and evenly distributed across the branches of the tree, phylogenies from any data set tend to converge (Mishler 1994) and such congruence between trees from different data sets provides strong evidence for any hypothesis of phylogenetic history.

It is clear, however, that whatever the data set used to derive relationships, monophyly of Australian *Cophixalus* first must be demonstrated.

Acknowledgments

We thank L. Jackson and J. O'Shea for field assistance and C. Hoskin for permission to quote unpublished data from his BSc (Hons) thesis and further studies. M. J. Tyler critically read the manuscript. We also thank the referees for constructive suggestions.

Fig. 5. Habitat of rocky boulders in Cape Melville National Park where *Cophixalus zweifeli* sp. nov. is found.

References

COVACEVICH, J. & INGRAM, G. J. (1978) An undescribed species of rock dwelling *Cryptoblepharus* (Lacertilia : Scincidae). *Mem. Qld Mus.* **18**, 151-154.

DINGERKUS, G. & UHLER, L. D. (1977) Enzyme clearing of Alcian Blue stained whole small vertebrates for demonstration of cartilage. *Stain Technol.* **52**, 229-231.

JAMIESON, B. G. M. (1997) Some new and previously known earthworm species from Cape York Peninsula (Annelida: Oligochaeta; Megascolecidae) *Mem. Qld Mus.* **42**, 233-270.

LITTLE, A. & HALL, L. S. (1996) Preliminary observations on the bats of Cape Melville National Park. *N. Qld Nat.* **34**, 53-57.

MCDONALD, K. R. (1997) A new stream-dwelling *Litoria* from the Melville Range, Queensland, Australia. *Mem. Qld Mus.* **42**, 307-309.

_____ (1998) First Queensland record of the burrowing frog *Cyclorana cryptotis* Tyler & Martin, 1977 (Anura:Hylidae). *Trans. R. Soc. S. Aust.* **122**, 85-86.

MISHLER, B. D. (1994) Cladistic analysis of molecular and morphological data. *Am. J. Phys. Authropol.* **94**, 143-156.

RICHARDS, S. J., DENNIS, A. J., TRENERRY, M. P. & WERREN, G. L. (1994) A new species of *Cophixalus* (Anura:Microhylidae) from northern Queensland. *Mem. Qld Mus.* **37**, 307-310.

SMITHE, F. B. (1975) "Naturalist's Color Guide" (American Museum of Natural History, New York).

TYLER, M. J. (1968) Papuan hylid frogs of the genus *Hyla*. *Zool. Verhandl.* (Leiden) **96**, 1-203.

_____ & DAVIES, M. (1986) 'Frogs of the Northern Territory' (Conservation Commission of the Northern Territory, Alice Springs).

ZWEIFEL, R. G. (1971) Results of the Archbold Expeditions No. 96. Relationships and distribution of *Genyophryne thompsoni*, a microhylid frog of New Guinea. *Amer. Mus. Novit.* **2469**, 1-13

_____ (1985) Australian frogs of the family Microhylidae. *Bull. Am. Mus. Nat. Hist.* **182**, 265-388.

_____ & PARKER, F. (1977) A new species of frog from Australia (Microhylidae:*Cophixalus*). *Am. Mus. Novit.* **2614**, 1-10.